CLAIMS

What is claimed is:

1. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece carrying the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece.

2. The magnetron as set forth in claim 1, wherein the upper pole piece comprises:

a ring-shaped magnetic flux receiving portion disposed between the permanent magnet and the anode to receive magnetic flux generated by the permanent magnet;

a slanted portion downwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to an upper portion of the predetermined space to carry received magnetic flux to the upper portion of the predetermined space; and

a magnetic flux dispersing portion upwardly slantingly extended from an inner edge of the slanted portion to disperse the carried magnetic flux.

3. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece carrying magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

at least one yoke; and

a lower pole piece comprising a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to a lower portion of the predetermined space to carry received magnetic flux to the lower portion of the predetermined space,

wherein the at least one yoke magnetically connects the permanent magnet to the lower pole piece.

4. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece having a magnetic flux concentrating structure to carry the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece.

5. The magnetron as set forth in claim 4, wherein the upper pole piece comprises a ring-shaped magnetic flux receiving portion disposed between the permanent magnet and the anode to receive magnetic flux generated by the permanent magnet, a slanted portion downwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to an upper portion of the predetermined space to carry received magnetic flux to the upper portion of the predetermined space, and a magnetic flux dispersing portion upwardly slantingly extended from an inner edge of the slanted portion to disperse the carried magnetic flux.

6. The magnetron as set forth in claim 5, wherein the lower pole piece comprises a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to the lower portion of the predetermined space to carry the received magnetic flux to the lower portion of the predetermined space.

7. The magnetron as set forth in claim 6, wherein an angle formed between the magnetic flux receiving portion and slanted portion of the lower pole piece is greater than an angle formed between the magnetic flux receiving portion and slanted portion of the upper pole piece.

8. The magnetron as set forth in claim 4, wherein the lower pole piece comprises a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to the lower portion of the predetermined space to carry the received magnetic flux to the lower portion of the predetermined.

9. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided below the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece carrying the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece.

10. The magnetron as set forth in claim 9, wherein the lower pole piece comprises a ring-shaped magnetic flux receiving portion disposed between the permanent magnet and the anode to receive magnetic flux generated by the permanent magnet, a slanted portion downwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to an upper portion of the predetermined space to carry received magnetic flux to the upper portion of the predetermined space, and a magnetic flux dispersing portion upwardly slantingly extended from an inner edge of the slanted portion to disperse the carried magnetic flux.

11. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

at least one yoke;

a lower pole piece carrying magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

an upper pole piece comprising a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to a lower portion of the predetermined space to carry received magnetic flux to the lower portion of the predetermined space; and

the at least one yoke magnetically connecting the permanent magnet with the lower pole piece.

12. A magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

a lower pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

an upper pole piece having a magnetic flux concentrating structure to carry the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece.

13. The magnetron as set forth in claim 12, wherein the lower pole piece comprises a ring-shaped magnetic flux receiving portion disposed between the permanent magnet and the anode to receive magnetic flux generated by the permanent magnet, a slanted portion downwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to an upper portion of the predetermined

space to carry received magnetic flux to the upper portion of the predetermined space, and a magnetic flux dispersing portion upwardly slantingly extended from an inner edge of the slanted portion to disperse the carried magnetic flux.

14. The magnetron as set forth in claim 13, wherein the upper pole piece comprises a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to the lower portion of the predetermined space to carry the received magnetic flux to the lower portion of the predetermined space.

15. The magnetron as set forth in claim 14, wherein an angle formed between the magnetic flux receiving portion and slanted portion of the upper pole piece is greater than an angle formed between the magnetic flux receiving portion and slanted portion of the lower pole piece.

16. The magnetron as set forth in claim 12, wherein the upper pole piece comprises a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to the lower portion of the predetermined space to carry the received magnetic flux to the lower portion of the predetermined space.

17. A microwave oven, comprising:

a magnetron as set forth in claim 1.

18. A high frequency heating apparatus, comprising:

a magnetron as set forth in claim 1.

19. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece carrying magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

at least one yoke; and

a lower pole piece comprising a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to a lower portion of the predetermined space to carry received magnetic flux to the lower portion of the predetermined space, wherein the at least one yoke magnetically connects the permanent magnet to the lower pole piece; and

a control unit to control an amount of heat produced by the heating unit.

20. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece having a magnetic flux concentrating structure to carry the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece; and

a control unit to control an amount of heat produced by the heating unit.

21. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided below the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece carrying the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece; and

a control unit to control an amount of heat produced by the heating unit.

22. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

at least one yoke;

a lower pole piece carrying magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

an upper pole piece comprising a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to a lower portion of the predetermined space to carry received magnetic flux to the lower portion of the predetermined space; and

the at least one yoke magnetically connecting the permanent magnet with the lower pole piece; and

a control unit to control an amount of heat produced by the heating unit.

23. A microwave oven, comprising:

a cooking cavity in which food is placed to be cooked;

a heating unit to heat the food, the heating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

a lower pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

an upper pole piece having a magnetic flux concentrating structure to carry the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece; and

a control unit to control an amount of heat produced by the heating unit.

24. A magnetron, comprising:

a concentric cathode-anode pair, the anode being a ring-shaped anode forming a plurality of resonance circuits and the cathode separated form the anode by a space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the space;

a lower pole piece carrying the magnetic flux to a lower portion of the space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece.

25. The magnetron as set forth in claim 24, wherein the upper pole piece comprises a ring-shaped magnetic flux receiving portion disposed between the permanent magnet and the anode to receive magnetic flux generated by the permanent magnet, a slanted portion downwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to an upper portion of the predetermined space to carry received magnetic flux to the upper portion of the predetermined space, and a magnetic flux dispersing portion upwardly slantingly extended from an inner edge of the slanted portion to disperse the carried magnetic flux.

26. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece carrying magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

at least one yoke; and

a lower pole piece comprising a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to a lower portion of the predetermined space to carry received magnetic flux to the lower portion of the predetermined space, wherein the at least one yoke magnetically connects the permanent magnet to the lower pole piece,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

27. The high frequency apparatus of claim 26, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

28. A high frequency apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece having a magnetic flux concentrating structure to carry the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

29. The high frequency apparatus of claim 28, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

30. A high frequency heating apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided below the anode;

an upper pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

a lower pole piece carrying the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

31. The high frequency apparatus of claim 30, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

32. A high frequency heating apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

at least one yoke;

a lower pole piece carrying magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

an upper pole piece comprising a ring-shaped magnetic flux receiving portion designed to receive magnetic flux carried through the at least one yoke from the permanent magnet, and a slanted portion upwardly slantingly extended from an inner edge of the ring-shaped magnetic flux receiving portion to a lower portion of the predetermined space to carry received magnetic flux to the lower portion of the activating space; and

the at least one yoke magnetically connecting the permanent magnet with the lower pole piece,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

33. The high frequency apparatus of claim 32, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.

34. A high frequency heating apparatus, comprising:

a high frequency particle accelerating unit comprising:

a magnetron, comprising:

a ring-shaped anode forming a plurality of resonance circuits;

a cathode disposed at an axial center of the anode to emit thermions, separated from the anode by a predetermined space;

a ring-shaped permanent magnet provided above the anode;

a lower pole piece having a magnetic flux dispersing structure to carry magnetic flux generated by the permanent magnet to an upper portion of the predetermined space;

an upper pole piece having a magnetic flux concentrating structure to carry the magnetic flux to a lower portion of the predetermined space; and

at least one yoke magnetically connecting the permanent magnet with the lower pole piece,

the magnetron generating a high frequency particle beam; and

a control unit to control an intensity of the high frequency particle beam.

35. The high frequency apparatus of claim 34, wherein the apparatus is one of: a high frequency heating apparatus, a particle accelerator and a radar unit.